Adipose-Induced Regeneration of Scalp (AIR-Scalp) to Treat Radiation Injury

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Abstract

Whole brain radiation therapy is a common treatment for cancer patients. After radiation, approximately 95% of the patients can experience acute and/or chronic side-effects: Radiation dermatitis, fibrosis, and chronic ulcers. The purpose of this study was to examine the effects of adipose-derived products (ADPs) in an animal model of radiation dermatitis. We hypothesized that ADPs would enhance wound healing and regenerate the skin; improving cellularity, vascularity, and decreasing scar tissue formation. Immunocompromised mice received a 0.5 cm skin incision on their scalp, which was closed with surgical glue. After 2 weeks, the mice received focal radiation using a 5 mm collimator: 0 Gy, 20 Gy single, and 40 Gy fractionated (8 Gy/day for 5 days) doses were used. After 2 weeks, mice were randomized into 4 groups and received a subcutaneous injection of 1) FAT-graft, 2) Stromal vascular fraction, 3) Adipose-derived mesenchymal stem cells, and 4) PBS. ADPs were isolated from lipoaspirate samples, obtained from non-cancer human patients. Two weeks after the ADPs treatments, mice were euthanized and skin samples were collected and processed for histology. Histological staining (H&E) was used to evaluate skin integrity after radiation. Results from the 20Gy group showed that the mice developed mild dermatitis 2 weeks after the radiation treatment that subsequently healed after ADPs treatment. No histological differences were observed between groups. While this study is ongoing (40Gy), it is hopeful that these results will offer an innovative way to treat radiation-induced damage in cancer patients.

Study Aims

1. Identify the therapeutic effect of AIR in the radiated scalp after surgery.
2. Determine the mechanism of action of ADPs on the reversal of radiation-induced scalp injury.

Methods

Surgical Approach: Mice were anesthetized with isoflurane, then a 0.5 cm skin incision was made on the scalp and closed with vetbond (surgical glue)

Radiation: Once the skin incision healed (~1 week), mice were anesthetized with isoflurane and radiation was delivered using a 5 mm round collimator

Fat harvest and separation of ADPs: Lipoaspirate was recovered from healthy human donors (IRB protocol was followed) and FAT-Graft, SVF, and Adipose-Derived MSCs were isolated (Figure 1)

Treatment: 10 ul of ADPs was subcutaneously injected into irradiated site

Measurement of Skin Integrity: Histological analysis (H&E) of irradiated skin (Figure 2)

Table 1: Experimental Design

Treatment	Radiation Applied			Endpoints
	0 Gy	Single 20 Gy	Fractionated 40 Gy (8 Gy/day for 5 days)	
Control (MSC Media)	12	12	12	Six mice from each group will be euthanized 2 and 4 weeks after the ADPs treatment
FAT-Graft	12	12	12	
SVF	12	12	12	
AdMSC	12	12	12	

Figure 1: Separation of ADPs

Collection of human lipoaspirate from healthy donors

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Decantation, Purification, and Isolation

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FAT-Graft

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Centrifugation

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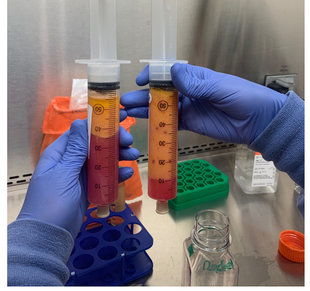
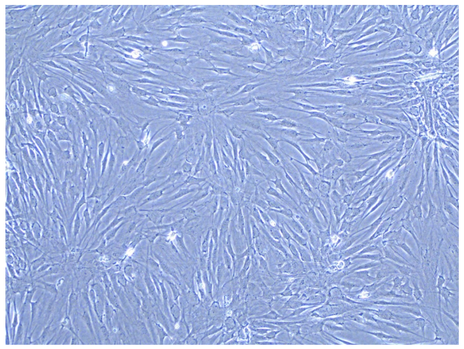
SVF AdMSC





Adipose-Derived MSCs

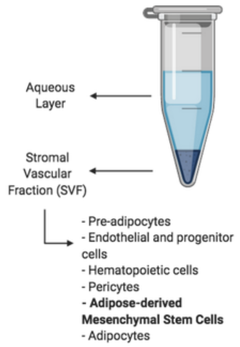
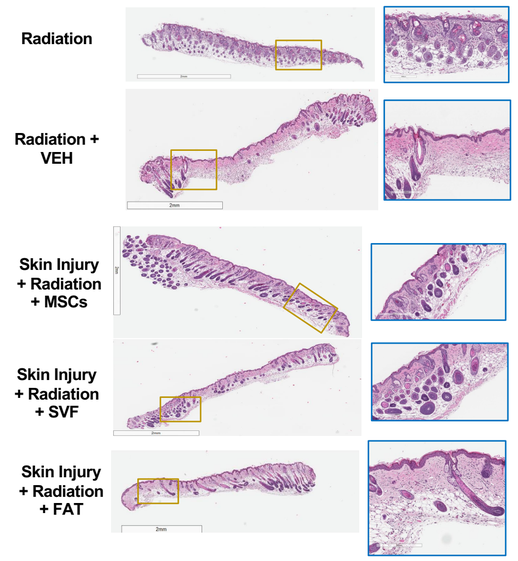


Figure 2: Histology



Results

- The 20 Gy group developed mild dermatitis 2 weeks after radiation
- The mild dermatitis healed upon application of ADPs
- No histological differences were observed between the different treatment groups

Discussion

This study is currently ongoing (40 Gy) but the utilization of ADPs to treat irradiation damage to the skin is promising. It is hoped that this study will provide a novel way to treat radiation-induced damage to the skin in cancer patients.

References

Forte AJ, R. Sarabia-Estrada. 2019. Adipose-Induced Regeneration of Scalp (AIR Scalp) to Treat Radiation Injury.